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## (54) METHOD OF FORMING PHOTORESIST RELIEF IMAGE

(57)Abstract:

PROBLEM TO BE SOLVED: To provide light absorbing composition, which can be used as antireflection covering composition which is useful when deep UV use is contained, especially a flattened covering layer is required.

SOLUTION: When a photoresist relief image is formed on a substrate having a topography, (a) a layer of antireflection composition containing polymer having molecular weight of at most about 8,000 is applied on the substrate, (b) the layer of a photoresist composition is applied on the antireflection composition layer, and (c) the photoresist layer is exposed to activated radiant rays, and the exposed photoresist layer is developed.

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**CLAIMS**

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[Claim(s)]

[Claim 1] the approach of forming a photoresist relief image on the base which has topography -- it is -- (a) - the approach of forming the photoresist relief image containing what the layer of the acid-resisting constituent containing the polymer which has about 8,000 or less molecular weight is applied on a base, and the layer of a photoresist constituent is applied on (b) this acid-resisting constituent layer, and a photoresist layer is exposed with (c) activation radiation, and the exposed photoresist layer develops for.

[Claim 2] The approach according to claim 1 by which heat curing is carried out before an acid-resisting layer applies a photoresist constituent layer.

[Claim 3] The approach according to claim 1 a polymer is about 6,000 or less molecular weight.

[Claim 4] The approach according to claim 1 a polymer is about 5,000 or less molecular weight.

[Claim 5] The approach according to claim 1 a polymer is about 3,000 or less molecular weight.

[Claim 6] The approach according to claim 1 a polymer includes an anthracenyl unit or a phenyl unit.

[Claim 7] The approach according to claim 1 an acid-resisting constituent is formed of local oxidation of silicon, and shows about 0.50 or more display flatness to the step which has the slope configuration which are width of face of 0.8 microns, and a midpoint depth of 2 microns.

[Claim 8] The approach according to claim 1 an acid-resisting constituent contains a cross linking agent compound further.

[Claim 9] The approach according to claim 1 an acid-resisting constituent contains a plasticizer compound further.

[Claim 10] The approach according to claim 9 a plasticizer compound is a non-polymer-like compound.

[Claim 11] The approach according to claim 9 a plasticizer compound is compound; which has phenyl or the aryl substituent of anthracene compound; a large number of a benzyl permutation, or a phenol system compound.

[Claim 12] The approach according to claim 9 a plasticizer compound is the oligomer which has about 2,000 or less molecular weight.

[Claim 13] The approach containing the resin which has Tg with an acid-resisting constituent lower than the temperature which substantial bridge formation of an acid-resisting constituent produces according to claim 8.

[Claim 14] The method according to claim 13 of heating an acid-resisting constituent to Tg of resin in general, although substantial bridge formation of an acid-resisting constituent does not take place after applying an acid-resisting constituent.

[Claim 15] The formation approach of a photoresist relief image including being the approach of forming a photoresist relief image on the base which has topography, applying the layer of the acid-resisting constituent containing (a) plasticizer compound on a base, and applying the layer of a photoresist constituent on (b) this acid-resisting constituent layer, and exposing a photoresist layer with (c) activation radiation, and developing the exposed photoresist layer.

[Claim 16] It is the approach of forming a photoresist relief image on the base which has topography. (a) The layer of the acid-resisting constituent containing the resin which has Tg lower than the temperature which produces substantial bridge formation of the acid-resisting constituent containing a plasticizer compound is applied on a base. And the formation approach of a photoresist relief image including applying the layer of a photoresist constituent on (b) this acid-resisting constituent layer, exposing a photoresist layer with (c) activation radiation, and developing the exposed photoresist layer.

[Claim 17] It is the approach of forming a photoresist relief image on the base which has topography. (a) The layer of the cross-linking acid-resisting constituent containing the resin which has Tg lower than the

temperature which produces substantial bridge formation of an acid-resisting constituent is applied on a base. (b) Although substantial bridge formation of an acid-resisting constituent is not produced, this acid-resisting constituent layer Heat to Tg of this resin in general at least, and the layer of a photoresist constituent is applied on (c) this acid-resisting constituent layer. And the formation approach of a photoresist relief image including exposing a photoresist layer with (d) activation radiation, and developing the exposed photoresist layer.

[Claim 18] The constituent which is an acid-resisting coat constituent used with the photoresist finished, and contains the resin which has Tg lower than the temperature which produces substantial bridge formation of 1 or the polymer which has about 8,000 or less molecular weight and (1) (2) plasticizer beyond it, and (3) constituents.

[Claim 19] The acid-resisting coat constituent according to claim 18 with which a polymer or resin includes an acrylate unit.

[Claim 20] The base which is a covered base and has the enveloping layer of (1) enveloping layer [ of an acid-resisting constituent according to claim 17 ]; and (2) photoresist on it.

[Claim 21] The base with which claim 20 whose base is a micro electro nick wafer base was covered.

[Claim 22] The covered base according to claim 20 whose base is a flat-panel display base.

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**DETAILED DESCRIPTION**

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**[Detailed Description of the Invention]**

[0001] This invention relates to the constituent which decreases the echo to the photoresist layer finished from the base of the radiation currently exposed. This invention relates to an acid-resisting coat constituent (antireflective coating compositions) applicable as an enveloping layer which carries out flattening about the base which forms a foundation more at a detail.

[0002] A photoresist is a photographic sensitive film used in order to imprint an image to a base. The enveloping layer of a photoresist is formed on a base. Then, a photoresist layer is exposed by the activation radiation source (activating radiation) through a photo mask. A photo mask has an opaque part and the part of an and also [ it is transparent to an activation radiation ] to an activation radiation. The exposure by the activation radiation causes the chemical conversion by the optical induction of photoresist coating, and imprints the pattern of a photo mask to the base covered with the photoresist by it. Following exposure, a photoresist is developed and offers the relief image (relief image) which a base can alternative process. It is known within the industry, for example, a common photoresist constituent is McGraw. Hill Book Deforest work of Company (New York) Photoresist Materials and Processes, 1975, Chapter 2, and Plenum The Moreau work of Press (New York), Semiconductor Lithography, Principles Practices and It is indicated by Materials, the 2nd, and Chapter 4.

[0003] The main applications of a photoresist are in semi-conductor manufacture. Here, the object is converting the semi-conductor slice by which the polish's was carried out to altitude, silicon, or a thing like gallium arsenide into the complicated matrix of the electronic flow pass (electron conducting paths) which achieves circuitry and which is geometry (1 micron or 1 micron or less) preferably. The suitable Foto Regis processing is a key for finishing this object. Although there is powerful interdependence between various photoresist down stream processing, exposure is one of the important processes in order to attain a photoresist image with high resolving power.

[0004] An echo of the activation radiation used for exposure of a photoresist restricts the resolution of the image by which a pattern is often carried out to a photoresist layer. An echo of the radiation from the interface of a base and a photoresist makes spatial fluctuation of the intensity of radiation in a photoresist cause. By this, the line breadth of the photoresist after development will become uneven. Moreover, radiations are scattered on the part of the photoresist of the range which does not ask for exposure from the interface of a base and a photoresist. Fluctuation of line breadth is caused also by this. Generally the amount of dispersion and an echo changes by the location. The heterogeneity of line breadth happens further by this. Fluctuation of the topography (topography) of a base also causes the problem of the echo which restricts resolution.

[0005] Thus, a new acid-resisting coat constituent is desired.

[0006] The artificer discovered carrying out the optimal operation, when a reflexivity prevention coat was generally the thickness of quarter wavelength on a reflecting surface. Therefore, in many cases, a KONFOMARU (conformal) acid-resisting coat will be liked.

[0007] However, in a certain kind of application, a KONFOMARU coat is not desirable. For example, the topography of a wafer or other bases has a vertical step, and cannot maintain enveloping layer thickness of desired quarter wavelength. In such a case, it is fond noting that a flattening acid-resisting coat constituent (planarizing antireflective coating composition) can lose fluctuation of the resist thickness on a vertical step. Since CD fluctuation is made as for such resist thickness of homogeneity to min and it can arrange all resists in the same height, it enlarges potentially the depth of focus which can be used. Furthermore, the activity of the flattening acid-resisting coat constituent to a such topography top can be comparatively exposed to dirty processing at homogeneity rather than what has the trench pin center, large (trench center) exposed to acid-

resisting ETCHI in the case of the clearing (clearing) of a side attachment wall.

[0008] This invention offers the new absorption-of-radiation constituent which can be used as an acid-resisting coat constituent (ARCs) with a photoresist constituent. Since ARCs of this invention can realize high flattening, it can be used for the above applications.

[0009] In the first mode of this invention, an acid-resisting constituent contains the resin binder component containing a comparatively low molecular weight polymer (Mw), for example, the molecular weight of about 8,000dalton or less, and the polymer which has about 7,000 and 6,000, or the molecular weight (Mw) of 5,000dalton or less still more preferably. The polymer or oligomer which has about 4,000 and 3,000, or the molecular weight (Mw) of 2,000dalton or less is also useful to the flattening ARCs of this invention. Generally, in this mode of this invention, low-molecular-weight resin has about 1,000 or the molecular weight (Mw) of 1,500dalton at least. The resin which often has an acrylate unit is desirable.

[0010] It turned out that ARCs of this invention which has such low-molecular-weight resin shows a good flattening property about application on a base front face. For example, ARCs of this invention can cover much topography like the step of the \*\* slope configuration in vertical, and offers a uniform and flat front face on these.

[0011] As further mode of this invention, Flattening ARCs contains the plasticizer compound of low molecular weight in comparison. Although various oligomer can be used as a plasticizer compound of the ARC constituent of this invention, a non-polymer-like compound is desirable. Typically, the plasticizer used for ARCs of this invention has about 2,000 or the molecular weight of 1,500dalton or less. It has about 1,000,800 or the molecular weight of 500dalton or less more preferably. Although the desirable plasticizer is comparatively non-volatile between lithography processings, it has sufficient molecular weight again. for example, -- at least -- about 150 or 200dalton, and/-- again -- It has more preferably about 160 degrees C of about 180 degrees C or the boiling points higher than about 200 degrees C.

[0012] To a suitable plasticizer, for example, an anthracene compound especially phenyl, or a benzyl substituted compound, For example, 9-(2', 4'-dihydroxy-3-methylbenzyl) anthracene; (3-hydroxyphenyl;) Many aryl substituents like [screw (3-cyclohexyl-4-hydroxy-6-methylphenyl;)] methane, compound;2 which have many phenyls or other cull BOSHUKU rucksack aryl substituents especially, and 6-screw (2' --) FENO rucksack compound which can have an addition carboxy rucksack aryl substituent like 4'-dihydroxy benzyl 4-methyl phenol; JI (C2-C16 alkyl) phthalate compound, for example, dioctyl phthalate and \*\* -- an alkyl phthalate compound [ like ] etc. is contained. As an example of oligomer, acrylate oligomer, such as oligomer of ethyl acrylate/glycidyl acrylate, is mentioned.

[0013] In case ARCs of this invention which has such a plasticizer compound is applied to base front faces including the base front face which has vertical and significant topography like the step of a slope configuration, it shows a good flattening property.

[0014] Flattening ARCs can have such two modes of this invention again. That is, low-molecular-weight resin can be included in a plasticizer compound and coincidence.

[0015] The cross-linking ARCs of this invention is often desirable. In a bridge formation system, one or more components enable the reaction which hardens the ARC enveloping layer applied by the approach of bridge formation or others. Such a bridge formation setup-of-tooling product includes bridge formation of one or more components of ARC preferably for induction, the acid to promote, or an acid generating compound, for example, a heat acid generator. Generally a desirable cross-linking acid-resisting constituent contains a separate cross linking agent component like the amine base matter. This invention includes the acid-resisting constituent with which significant bridge formation does not take place again, while being used with a photoresist constituent.

[0016] The further mode of this invention is related with the application approach of a flattening ARC constituent. It includes heating the ARC enveloping layer applied in order to offer the fluidity of applying an ARC constituent on a base, and a constituent generally in this approach. Surface smoothness is raised by these. A photoresist is applied on an ARC layer after that.

[0017] In this approach, when an ARC constituent is a cross-linking constituent, flow temperature (flow temperature) must be made lower than the temperature which produces significant bridge formation of an ARC constituent. For example, such flattening cross-linking ARC can contain the resin which has a glass transition temperature (Tg) lower than the temperature which produces bridge formation of a substantial ARC constituent. In such ARCs, the bridge formation of a constituent with applied significant ARC is not caused, but floating of an ARC constituent occurs and it is heated by the temperature near Tg of this resin which can attain the surface smoothness of high level. Then, since significant bridge formation is produced, an ARC constituent is further heated by temperature higher than Tg of this resin. the temperature from

which Tg of ARC resin produces significant bridge formation of an ARC constituent preferably -- at least -- about 10 degrees C and 15 degrees C -- or it is low 20 degrees C. the temperature from which Tg of ARC resin produces significant bridge formation of an ARC constituent still more preferably -- at least -- about 25 degrees C, 30 degrees C, and 35 degrees C -- or it is low 40 degrees C. Low Tg resin including an acrylate unit is often liked. Here, it is defined as reference of the vocabulary similar to "the temperature which produces significant bridge formation of an ARC constituent", or this meaning the temperature of the cross linking agent component of an ARC constituent to which about 20 mole percents react at least, when exposed to the temperature concerned for 60 seconds.

[0018] ARCs which has such low Tg resin is offered by many means. For example, the ARC resin which can make Tg of resin low and which contains an "elastic" monomer per polymerization comparatively can be used. The low-grade alkyl (for example, C 1-4) ester corresponding to diethylene-glycol methacrylate, diethylene-glycol acrylate, and these as an example of an elasticity monomer, Especially  $\text{CH}_2=\text{C}(\text{CH}_3)(\text{O})\text{OCH}_2\text{CH}_2\text{OCH}_3$ ,  $\text{CH}_2=\text{CHC}(\text{O})\text{OCH}_2\text{CH}_2\text{OCH}_3$ ,  $\text{CH}_2=\text{CHC}(\text{O})\text{OCH}_2\text{CH}_2\text{OCH}_2\text{CH}_2\text{OCH}_3$ , and  $\text{CH}_2=\text{C}(\text{CH}_3)\text{C}(\text{O})\text{OCH}_2\text{CH}_2\text{OCH}_2\text{CH}_2\text{OCH}_3$  grade -- methyl ester; ethylene glycol methacrylate And ethylene glycol acrylate; on the alkyl acrylate and the type target which have four or more carbon atoms Hydroxyalkyl methacrylate with the hydroxyalkyl substituent which has what has a 4 to about 16 carbon atom, n-butyl acrylate;, and the carbon atom of 4 to about 16 or acrylate;, and these things [ like ] are included.

[0019] The difference of such temperature with floating of an ARC constituent and bridge formation is offered by various different means. It is that an ARC constituent constructs a bridge over the bottom of existence of an acid, and this constituent contains the heat acid generator higher than Tg of ARC resin which generates an acid only when exposed to comparatively high temperature as a desirable means. For example, 80 degrees C of desirable heat acid generators used in this mode of this invention are about 70 degrees C or the thing (an acid is generated) activated at least still more preferably by about 90 degrees C or long exposure [ in / at least / still more preferably / 100 degrees C / about 110 degrees C or 120 degrees C ] (for example, at least 30 seconds) at least.

[0020] This invention also includes the ARC constituent which contains still such low Tg resin in the object containing one of the thing of other modes of this invention mentioned above, i.e., low-molecular-weight resin, and plasticizer compound \*\*, or two.

[0021] But the acid-resisting constituent of this invention can be suitably used with which of a positive type and a negative-mold photoresist constituent.

[0022] This invention offers the new manufacture article which consists of the approach of forming a photoresist relief image further, and a base which was independent or covered the acid-resisting constituent of this invention with the photoresist constituent. A flat-panel display base like for example, a micro electro nick wafer and a liquid crystal screen base is included in the typical base covered with the acid-resisting constituent of this invention. Other modes of this invention are described later.

[0023] As mentioned above, in the first mode, the acid-resisting constituent of this invention contains a low-molecular-weight polymer. A low-molecular-weight polymer constituent can offer the coat by which flattening is carried out to altitude.

[0024] Extent of the surface smoothness of an enveloping layer is shown as "display flatness (degree of planarity)" or "DOP." Here, "DOP" is defined like [ topography / with a step ] a degree type.

$\text{DOP} = 1 - \text{R1} / \text{R2}$  -- here, R1 is the maximum of the "impression depth" of the ARC constituent on a step. R2 is the depth of a step. This relation when calculating DOP is further shown in drawing 1 . The base 10 and the ARC layer 12 which have the step (what is formed of local oxidation of silicon) of a slope configuration are described by drawing 1 . In this drawing, the quotient of the value of R1 and R2 shown in drawing 1 lengthened one is equal to DOP for this coat. The "display flatness" currently used here or the vocabulary of "DOP" says the value lengthened one (R2 broken R1), as mentioned above and illustrated to drawing 1 .

[0025] Desirable ARCs of this invention is formed by the local oxidation (local oxidation of silion, LOCOS) procedure of silicon, and shows about 0.5 DOP at least to the step which has the slope configuration which are width of face of 0.8 microns, and a midpoint depth (mid-point depth) of 2 microns. DOP of about 0.55 or 0.60 is more preferably shown to such a configuration. About 0.65 DOP is shown to such a configuration further more preferably.

[0026] As mentioned above, in the first mode of this invention, Flattening ARCs is offered as a thing containing low-molecular-weight resin. Various matter can be used as a low-molecular-weight polymer of ARCs. A low-molecular-weight polymer shows the suitable property for using it for a desired application. Especially this polymer can be dissolved to the selected solvent.

[0027] In the cross-linking ARCs of this invention, it is suitable for a polymer to include the part which carries out other constituent components and reactions for constructing a bridge. Other ARC components can act as a kind of cross-linking like other polymers.

[0028] As for the polymer of an acid-resisting constituent, as an object for deep UV, it is desirable to absorb an echo effectively in the deep UV range (typically about 100 to 300nm). Therefore, as for a polymer, it is desirable to include the chromophore (deep UV chromophores) unit for deep UV, i.e., the unit which absorbs a deep UV radiation. Generally a strong conjugation component is a suitable chromophore. It is typically desirable as aromatic series especially polynuclear hydrocarbon or a heterocycle type unit, and a \*\* deep UV chromophore. For example, the radical which has 2 to 3 which each ring of is eight membered-rings from three membered-rings, and has nitrogen, oxygen, or three sulfur elements in each ring from 0, the four condensed rings, or a separate ring is raised. A permutation and unsubstituted phenan tolyl, a permutation and an unsubstituted anthra sill (anthracyl), a permutation and an unsubstituted acridine (acridine), a permutation and unsubstituted naphthyl (naphthyl), a permutation, unsubstituted kino RINIRU (quinolinyl), and ring permutation kino RINIRU like a hydroxy quinolinyl group are contained in such a chromophore. A permutation or especially an unsubstituted anthra sill radical is desirable. A desirable resin binder has a pendant anthracene radical. In desirable resin, it is Shipley. A thing like the formula 1 currently indicated by the 4th page of A2 the application No. 813114 exhibited in Europe of Company is contained.

[0029] Other desirable resin binders contain the kino RINIRU derivative which has one or more nitrogen like a permutation, unsubstituted kino RINIRU, or hydroxy kino RINIRU, oxygen, or a sulfur element. A polymer can include the alkyl ester unit which is carrying out the pendant to the principal chain of a unit like carboxy, and/or a polymer. Especially desirable acid-resisting constituent resin is an acrylic polymer including such a unit, for example, is Shipley. It is like the resin of the formula 2 currently indicated by 4 to 5 of A2 pages the application No. 813114 exhibited in Europe of Company.

[0030] In order to carry out image formation in 193nm, an ARC constituent contains preferably the resin which has a phenyl chromophore unit. For example, one of the ARC resin desirable in order to use it with the photoresist which carries out image formation by 193nm is a terpolymer (30:38:32 mole ratios) which consists of the polymerization unit of styrene, 2-hydroxyethyl methacrylate, and methyl methacrylate. The activity in such phenyl resin and an ARC constituent is Shipley. It is indicated by the U.S. patent application (the application number 09 / 575, filing-date-of-application September 15, 1998) transferred to Company. [ 153 and 575 ]

[0031] As for the low-molecular-weight resin of the acid-resisting constituent of this invention, it is desirable to be compounded by carrying out the polymerization of the two or more different monomers. A chromophore like anthracenyl, kino RINIRU, or a hydroxy quinolinyl group is included in at least one of these the monomers. A free radical polymerization is suitable. For example, in order to offer desirable and various units under existence of the bottom of an inert atmosphere (for example, nitrogen or an argon) and the temperature up above about 50 degrees C and a radical initiator, two or more monomers are made to react. Reaction temperature varies with the reactivity of the boiling point and the used concrete reagent of a reaction solvent (if the solvent was used). Various reaction solvents, such as an aromatic series solvent like propanol, a butanol and benzene, a chlorobenzene, toluene, and a xylene, can be used. Dimethyl sulfoxide, dimethylformamide, propylene Glycol The monomethyl ether, ethyllactate, and THF are also suitable. As for a solvent, being deaerated before addition of a reagent is desirable. A chain transfer agent like t-dodecyl thiol can also be used. According to the matter currently indicated here, the suitable reaction temperature to each system can be experientially determined easily, if it is this contractor. It can be used in order that various radical initiators may prepare the copolymer of this invention. For example, an azo compound like - azobis (2-methyl butanenitrile), and 2 and 2 '2, 2'-azobis (2, 4-dimethyl pentane nitril), the azo-screw -2, and - isobutyronitrile (azobisuisobutironitoriru), and 2 '1, 1'-azobis (cyclohexane carbonitrile) can be used. peroxide, par ester, and a par -- acid and par sulfate can also be used. The below-mentioned examples 1-4 can be referred to as instantiation of a reaction condition.

[0032] Although it cannot say that it is not much desirable, the resin by which preforming was carried out can be organic-functions-ized per chromophore. For example, glycidyl FENO rucksack resin like a glycidyl novolak can be made to react with an anthranil carboxylic acid.

[0033] The resin of the acid-resisting constituent of this invention shows the absorbance as which deep UV wavelength like the range of 100 to about 300nm is sufficient. In more detail, in the exposure wavelength (for example, about 248nm or about 193nm) used, even if there are few desirable resin binders of this invention per micron, they have the optical density of 3 absorbance units (Absorb. units/mu). In exposure wavelength, 20 or more absorbance units are desirable from per [ 5 / about ] micron. In the exposure

wavelength used, it has 16 or more absorbances from per [ 4 / about ] micron still more preferably. The value of the high absorbance to each resin can be acquired by raising the percentage of the chromophore unit in resin.

[0034] Although the acid-resisting constituent resin which has such an absorptivity chromophore is generally suitable, the acid-resisting constituent of this invention can contain other resin as KOREJIN (co-resin) or an independent resin binder component. For example, phenols like Pori (vinyl phenol) and a novolak can be used. Such resin is Shipley. European Patent applications [ EP and Thacheray ] 542008 of Company et It is indicated by United States patent 5,851,738th of al. Other resin described below as a photoresist resin binder can be used as a resin binder component of the acid-resisting constituent of this invention.

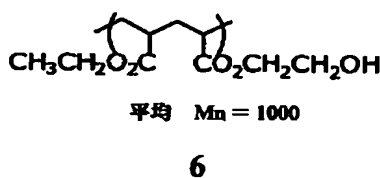
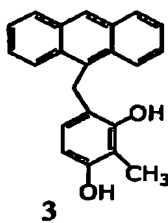
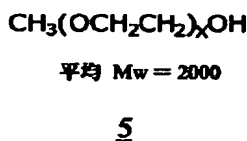
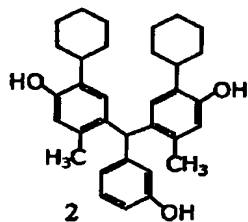
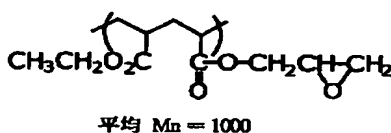
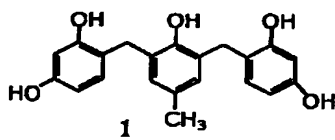
[0035] The concentration of the resinous principle of the acid-resisting constituent of this invention can change in the comparatively large range. Generally a resin binder is used in the concentration of about 50 to 95 percentage by weight of the whole desiccation component of an acid-resisting constituent. More typically, it is about 60 to 90 of all desiccation components (all components except a solvent carrier) percentage by weight.

[0036] Various compounds can use it as a plasticizer of the acid-resisting constituent of this invention. Supposing it asks for a plasticizer raw material, it can also contain an exposure absorption-of-radiation chromophore. As a suitable plasticizer, for example, an anthracene compound especially phenyl, or a benzyl substituted compound, For example, 9-(2', 4'-dihydroxy-3-methylbenzyl) anthracene; Many aryl substituents, Many the phenyl or other cull BOSHIKU rucksack aryl substituents especially (3-hydroxyphenyl;) like [screw (3-cyclohexyl-4-hydroxy-6-methylphenyl;)] methane, The compound which \*\*\*\*; FENO rucksack compound which can have additional cull BOSHIKU rucksack aryl substituent, 2 [ for example, ], and 6-screw (2', 4'-dihydroxy benzyl) 4-methyl phenol;; and these things [ like ] are mentioned. A non-polymer-like plasticizer is desirable for many applications. However, an oligomer plasticizer can also be used as mentioned above. As desirable oligomer, acrylate oligomer like the oligomer of ethyl acrylate/glycidyl acrylate etc. is mentioned. Generally, the oligomer plasticizer used with the ARC constituent of this invention has the joint unit of about 2, and 3, 4 or 5 on about 2, the joint unit of 3, 4, 5, 6, or 7, and a twist type target. The oligomer plasticizer of ARCs of this invention has about 2,000 or 1,500 or less molecular weight more preferably about 3000 or less.

[0037] The compounds 1-6 of the following [ plasticizer / desirable / which is used for ARCs of this invention / concrete ] are mentioned. 4 to 6 is oligomer.

[0038]

[Formula 1]





[0039] As for a plasticizer compound, it is desirable to exist in the amount of about 5 to about 50 percentage by weight on the basis of the total solids (all components except a solvent carrier) of an ARC constituent. It is about 10 to 30 of the total solids of an ARC constituent, or 40 percentage by weight more preferably. It is that 20 percentage by weight of plasticizers is especially added on the basis of the total solids of an ARC constituent preferably.

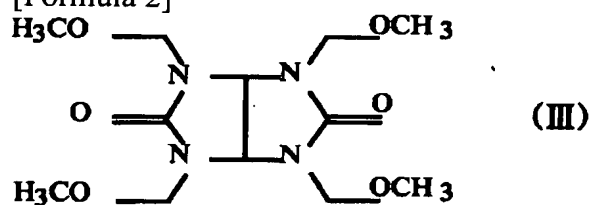
[0040] Generally ARC of this invention containing low Tg resin can be prepared by using an elasticity monomer in resin composition, as mentioned above about low-molecular-weight resin. Refer to the following examples 3 and 4 for the example of a reaction condition. Low Tg resin can also have low molecular weight so that it may be stated here. As mentioned above, suitable "elasticity" monomer For example, diethylene-glycol methacrylate, diethylene-glycol acrylate; ethylene glycol methacrylate, and ethylene glycol acrylate; Four or more carbon, Hydroxyalkyl methacrylate or acrylate in which alkyl ARI rate and n-butyl acrylate; which has 4 to about 16 carbon, and a hydroxyalkyl substituent have 4 to about 16 carbon typically, For example,  $\text{CH}_2=\text{C}(\text{CH}_3) \text{COO}(\text{CH}_2\text{CH}_2\text{O}) \text{CH}_2\text{CH}_2\text{OH}$  (monomer known as "HEMA-5"); etc. is included.

[0041] Generally the bridge formation mold acid-resisting constituent of this invention contains the further cross linking agent component. Various cross linking agents including the acid-resisting constituent cross linking agent currently indicated by the European Patent application No. 542008 of Shipley incorporated here as reference can be used. For example, as a suitable acid-resisting constituent cross linking agent, it is American. It is manufactured by Cyanamid and the cross linking agent of the amine base like the melamine matter containing melamine resin which is sold with the trademark of Cymel 300, 301, 303, 350, 370, 380, 1116, and 1130 is mentioned. American Especially glycoluril including the glycoluril (glucourils) which can come to hand from Cyanamid is suitable. It is American at the identifier of Cymel 1123 and 1125. It is American from Cyanamid at available benzoguanamine resin and the identifier of Beetle 60, 65, and 80. The matter of the benzoguanamine (benzoquanamines) containing resin like the urea-resin which can come to hand from Cyanamid, and the urea base is also suitable. commercial -- an available thing -- in addition, the resin of such the amine base can be prepared by the reaction with the copolymer of the formaldehyde for example, in the inside of an alcoholic content solution, acrylamide, or methacrylamide, or copolymer-ization with N-alkoxy methylacrylamide or methacrylamide, and other suitable monomers.

[0042] Especially the acid-resisting constituent cross linking agent of whenever [ like methoxy MECHIRETO-ized glycoluril / low-salt radical ] is desirable. Especially a desirable cross linking agent is methoxy MECHIRETO-ized glycoluril shown in a degree type (III).

[0043]

[Formula 2]



[0044] This methoxy MECHIRETO-ized glycoluril can be prepared with a well-known means. This compound is American at the trademark of Powderlink 1174 again. Cyanamid It can obtain commercially from Co. A polyfunctional compound like the phenyl which has a hydroxy compound and hydroxyalkyl [ like a C1-8 hydroxyalkyl substituent ] substituent especially whose one or more hydroxy \*\*\*\* are, or other aromatic series radicals is included in the cross linking agent of whenever [ other suitable low-salt radical ]. Generally a phenolic compound especially like the phenyl or other aromatic compounds which have the G methanol phenol ( $\text{C}_6\text{H}_3(\text{CH}_2\text{OH})_2\text{OH}$ ) which has the approaching hydroxy (one to two endocyclic elements) \*\*\*\* hydroxyalkyl substituent and other compounds, and HIDOROKISHI of at least approaching 1 with one or more methanols or other hydroxyalkyl ring substituents, and such a hydroxyalkyl substituent is desirable.

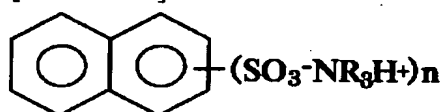
[0045] It was discovered that the cross linking agent of whenever [ like the methoxy MECHIRETO-ized glycoluril used with the acid-resisting constituent of this invention / low-salt radical ] offers the outstanding lithography operating characteristics including a remarkable reduction (SEM trial) of the footing (footing) of the relief image of the finished photoresist or an undercut (undercutting). Generally the cross linking agent component of the acid-resisting constituent of this invention exists in the amount of 5 to 50 percentage by

weight of the total solids (all components except a solvent carrier) of an acid-resisting constituent. It exists still more typically in the amount of about 7 to 25 percentage by weight of total solids.

[0046] In order to promote or carry out the catalyst of the bridge formation while hardening the enveloping layer of an acid-resisting constituent, as for the cross-linking acid-resisting constituent of this invention, it is desirable that an acid or an acid generating compound, especially a \*\*\*\* generating compound are included further. Preferably, a heat acid generator, i.e., the compound which an acid generates by heat treatment, is used. Alkyl ester \*\* of various well-known heat acid generators, 2, 4, and 4, 6-tetrabromo cyclohexa JIENON (2, 4, 4, 6-tetrabromocyclohexadienone), benzoin tosylate (benzoin tosylate), 4-nitrobenzyl tosylate, and other organic sulfonic acids is used suitably. [ for example, ] Generally the compound which generates a sulfuric acid by activation is desirable. Typically, a heat acid generator exists in an acid-resisting constituent by the concentration of about 0.1 to 10 percentage by weight of all the desiccation components of a constituent. It is about 2 percentage by weight of all desiccation components more preferably.

[0047] As for a heat acid generator, in the "multistage hardening (multi-cure)" approach of this invention of carrying out bridge formation processing at temperature high as mentioned above, after performing low floating heat treatment (low flow thermal treatment), it is desirable to use what (for an acid to be generated) is activated at comparatively high temperature. : by which the amine salt of an aryl sulfonic acid like the compound shown in a degree type is contained in a desirable elevated-temperature activity heat acid generator [0048]

[Formula 3]

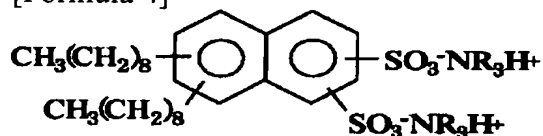


[0049] Here, R is alkyl which has hydrogen or 1 to about 6 carbon independently, respectively, n is 1 or 2, it is 2 preferably and a naphthyl ring can be permuted by the alkyl which has 1 to about 16 carbon in the location of arbitration.

[0050] Especially a desirable heat acid generator has the following structure expression (R is the same as that of the above-mentioned definition). This is King of the U.S., Norwalk, and Connecticut. It can obtain commercially by the trade name of NacureX 49-110 from Industries and Inc.

[0051]

[Formula 4]



[0052] The acid can blend easily [ an acid-resisting constituent ] rather than a heat acid generator. In order to make it an acid not promote especially the reaction which is not desirable as for a constituent component before the activity of an acid-resisting constituent, for hardening, it is blended in the acid-resisting constituent which needs heating in existence of an acid. Such mixture, such as strong acid like a sulfonic acid like toluenesulfonic acid, methansulfonic acid, and a triflic acid (triflic acid), is contained in a suitable acid.

[0053] In case this invention is used with a photoresist constituent, it contains the acid-resisting constituent which does not carry out significant bridge formation again. Such a non-cross-linking acid-resisting constituent does not need to include a cross linking agent component or crosslinking reaction for induction, the acid for promoting, or a heat acid generator. In other words, such a non-cross-linking acid-resisting constituent does not have thoroughly an acid front face (acid surface) for promoting a cross linking agent component and/or crosslinking reaction typically, or there is intrinsically (that is, fewer than about 1 or the amount percent of duplexes). [ no ]

[0054] The acid-resisting constituent of this invention contains control or one or more photograph acid generators (namely, "PAG") of sufficient amount to prevent substantially for the footing or notching (notching) of a photoresist layer which is finished and which is not desirable again. In this mode of this invention, a photograph acid generator is not used as the acid source (source) for promoting crosslinking reaction. Preferably, in the case of Cross-linking ARC, a photograph acid generator is not activated during bridge formation of an acid-resisting constituent, and on parenchyma. Since PAG is activated between

exposure of the resist layer by which the degree was finished and an acid is generated especially about the acid-resisting constituent by which heat bridge formation is carried out, the acid-resisting constituent PAG must be substantially stable on condition that crosslinking reaction. In a detail, desirable PAGs does not decompose or deteriorate substantially in exposure with a temperature [ for 5 to 30 minutes or more ] of 150 to 190 degrees C. [ about 140 or ] Such PAG in an acid-resisting coat constituent and these activities are Shipley. Pavelchek transferred to Company It is indicated by No. 61845 United States patent application of the application number 08th for which it applied on February 6, 1997 of etal / No. 797,741, and this response Japan Heisei 10 patent application.

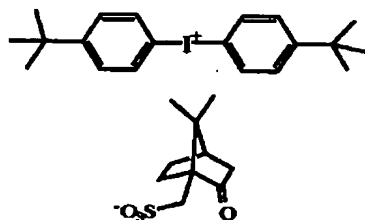
[0055] For at least some acid-resisting constituents of this invention, the acid-resisting constituent photograph acid generator for which it acts on as a surface active agent, and gathers near the upper part of the acid-resisting constituent near the interface of an acid-resisting constituent / resist enveloping layer is desirable. Especially the desirable acid-resisting constituent photograph acid generator of this invention is activity at exposure of a deep UV radiation especially about 248nm, about 193nm, and/or about 157nm\*\*, as effectively used with the deep UV photoresist by which an acid-resisting constituent is finished. The suitable photograph acid generator of an acid-resisting constituent and the suitable photograph acid generator of a photoresist constituent are activated on the same exposure wavelength. When using the acid-resisting constituent of this invention with a photoresist constituent, it is still more desirable that an acid-resisting constituent light activity compound and a photoresist light activity compound generate the same or, almost same acid compound (Mitsuo product (photoproduct)) in exposure of the activation radiation in the case of the exposure of a photoresist layer. That is, it is desirable to have the diffusion property which said Mitsuo product approximates, and the acid strength to approximate. Refer to the United States patent application number No. 61845 quoted above 08/797,741 and the Japanese Heisei 10 patent application.

[0056] An onium salt can be used as a photo-oxide generating agent of the acid-resisting constituent of this invention. The United States patent applications 08/797,741 which quoted the example of a suitable onium salt above, and Japanese Heisei 10 patent-application No. 61845 and U.S. Pat. No. 4,442,197; it can see to No. 4,603,101 and No. 4,624,912.

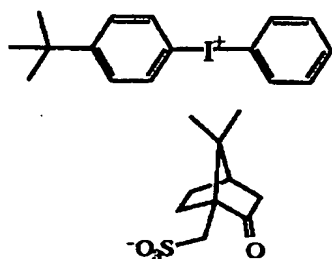
[0057] A permutation diphenyliodonium camphor (camphor) sulfonate compound is desirable onium PAGs for the acid-resisting constituent of this invention, and especially its sulfonate salt is desirable. Especially two desirable matter is : [0058] which is the degree type 1 and PAGS 2.

[Formula 5]

1



2



[0059] Such an iodonium compound is prepared as indicated by the Europe patent application 96118111.2 (open number 0783136) which explains composition of the above PAG 1 in full detail.

[0060] Other suitable PAGS(s) contain sulfonate-ized ester and sulfonyl oxyketone. Benzoin tosylate, t-butylphenyl Alpha (p-toluenesulfonyloxy)-acetate and t-butyl J.of containing alpha (p-toluenesulfonyloxy)-acetate which is indicating suitable sulfonate PAGS Photopolymer Science and Refer to Technology and 4(3):337-340 (1991). Desirable sulfonate PAGs is Sinta. et It is indicated by U.S. Pat. No. 5,344,742 of al.

[0061] Other useful acid generators contain the family of nitrobenzyl ester, and s-triazine derivative in the acid-resisting constituent of this invention. Suitable s-triazine acid generator is indicated by U.S. Pat. No. 4,189,323.

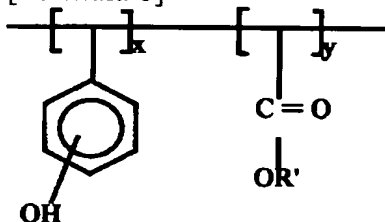
[0062] Halogenation, nonionic, and a photo-oxide generating compound are also suitable for the acid-resisting constituent of this invention. for example, 1 and 1-screw [p-chlorophenyl]-screw [ 2, 2, 2-trichloroethane (DDT);1, and 1-] [p-methoxyphenyl] - 2, 2, 2-trichloroethane;1, 2, 5, 6 and 9, 10-hexa BUROMO cyclo decane;1, and 10-dibromo decane; etc. is mentioned. A suitable photo-oxide generating agent is Sinta again. et It is indicated by the Europe patent application No. 0164248 of al, No. 0232972;, and U.S. Pat. No. 5,362,600.

[0063] The acid-resisting constituent of this invention can contain further the color compound which absorbs the radiation used for exposure of the finished photoresist layer again. The additive of other arbitration is a surface lubricating agent, for example, Union. The lubricating agent which can come to hand by the trade name of Carbide to Silwet7604, or 3M The surfactants FC171 or FC431 which can come to hand from Company are included.

[0064] ARCs of this invention can be prepared by the well-known means. A liquefied coat constituent is made and the component of an acid-resisting constituent is dissolved in such a suitable solvent. For example, ethyllactate or 2-methoxy ethyl ether (diglyme), Ethylene glycol monomethyl ether and one or more glycol ether like propylene glycol monomethyl ether; Methoxybutanol, The solvent which has both ether like an ethoxy butanol, methoxy propanol, and ethoxy propanol, and hydroxy part; Methyl-cellosolve acetate, Ethylcellosolve acetate, propylene-glycol-monomethyl-ether acetate, Other solvents like the ester and 2 base ester like dipropylene-glycol-monomethyl-ether acetate, propylene carbonate, and a gamma-butyrolactone are suitable. The concentration of the desiccation component in a solvent changes with some factors [ like ] which are the approach of spreading. Generally, the solid content content of an acid-resisting constituent changes between about 0.5 to 20 of the total weight of an acid-resisting constituent percentage by weight. Preferably, a solid content content changes between about 2 to 10 of the total weight of an acid-resisting constituent percentage by weight.

[0065] Various photoresist constituents can use it with the acid-resisting constituent of this invention. The photo-oxide generating constituent of a positive type and a negative mold is contained in this photoresist constituent. The photoresist used with the acid-resisting constituent of this invention contains a photo-oxide generating agent compound in a resin binder, and a photograph active ingredient and a type target generally. Preferably, a photoresist resin binder has a functional group for giving alkali water-solution development ability to the resist constituent by which image formation was carried out. Generally, especially the desirable photoresist for using it with the acid-resisting constituent of this invention is a resist of a positive type and a negative mold amplified chemically. many chemical magnification resist constituents -- for example, U.S. Pat. No. 4,968,581;4,883,740;4,810,613; -- it is indicated by 4,491,628 and 5,492,793. These all are incorporated here as reference for the suggestion of manufacture of a chemical magnification positive resist, and an activity. Especially a desirable chemical magnification photoresist contains the mixture of the resin binder containing a copolymer including both a photo-oxide generating agent, a phenol system, and a non-phenol system unit in using it with the acid-resisting constituent of this invention. For example, one desirable group of such a copolymer has an acid lei building radical (acid labile group) only per non-phenol system of a copolymer intrinsically or thoroughly substantially. Especially one desirable copolymer binder is : [0066] which has the repeat unit x of a degree type, and y.

[Formula 6]



[0067] Here, a hydroxy group exists in the whole copolymer in the location of rear-spring-supporter alt. \*\* meta or Para, and R' has the carbon atom of 1 to about 6, or 8 on the permutation which has the carbon atom of 1 to about 18 or unsubstituted alkyl, and a general twist target. Generally Tert-butyl is desirable R' radical. R' radical can be permuted by arbitration by one or more halogens (especially F, Cl, or Br), two to C1-8 alkoxy \*\*C8 alkenyl, etc. Unit x and y can exist at random through alternation or a polymer regularly in a copolymer. Such a copolymer can be formed easily. For example, about the resin of the above-mentioned formula, the polymerization of a permutation or unsubstituted alkyl acrylate, such as a vinyl phenol and t-butyl acrylate, can be carried out under the free radical conditions known by this contractor. The parts of a permutation ester part, i.e., R'-O-C(=O)-, and acrylate act as an acid lei building radical of resin, and produce the cleavage by which induction was carried out to photo-oxide by exposure of the enveloping layer of the photoresist containing resin. desirable -- a copolymer -- about 8,000 to about 50,000 molecular weight -- while having about 15,000 to about 30,000 molecular weight (Mw) more preferably -- about three or less molecular weight distribution -- it has two or less molecular weight distribution more preferably. It can be used as a resin binder in a copolymer vinyl alycyclic [ like alkyl methacrylate like non-phenol nature resin, for example, t-butyl acrylate, or t-butyl methacrylate, vinyl norbornyl (vinyl norbornyl), or a vinyl cyclohexanol compound ] (vinylalicyclic), and the constituent of \*\*\*\*\*. Such a copolymer can be prepared by such free radical polymerization or other well-known means. This copolymer has about 8,000 to about 50,000 molecular weight (Mw), and about three or less molecular weight distribution suitably. The further desirable chemical magnification positive resist is Sinta. et U.S. Pat. No. 5,258,257 of al; Thackeray et al U.S. Pat. No. 5,700,624; and Barclay et It is indicated by U.S. Pat. No. 5,861,231 of al.

[0068] The acid-resisting constituent of this invention can be used with other positives resist again. Hydroxy \*\*\*\* contains the constituent containing the resin binder which has a polar functional group like carboxylate. Although this resin binder enables it to develop a resist in an alkali water solution, it is used for a resist constituent in sufficient amount. The resist resin binder generally liked is phenol resin containing the gay and copolymer of the gay of the phenolaldehyde condensate and alkenyl phenol which are known by this contractor as novolak resin, a copolymer, and N-hydroxyphenyl-maleimide.

[0069] The desirable negative-resist constituent for using it with the acid-resisting constituent of this invention contains the mixture and the photo-oxide generating agent of the matter which harden, and construct a bridge or solidify by exposing in an acid (harden).

[0070] Especially a desirable negative-resist constituent contains a resin binder like phenol system resin, a cross linking agent component, and the optical active ingredient of this invention. About such a constituent and its usage, it is Thackeray. et It is indicated by the Europe patent application 0164248 and 0232972 and United States patent 5,128,232nd of al. Phenol system resin desirable although it is used as a resin binder component contains novolaks and Pori (vinyl phenol) which were mentioned above. The matter of the amine bases including a melamine, glycoluril, and the benzoguanamine base and the matter of the urea base are included in a desirable cross linking agent. Generally melamine formaldehyde resin is the most desirable. Such a cross linking agent can come to hand commercially. For example, melamine resin is American. It is sold at the trade name of Cymel 300, 301, and 303 from Cyanamid. Glycoluril resin is American. It is sold by the trade name of Cymel 1170, 1171, and 1172 and Powderlink1174 from Cyanamid. Urea base resin is sold by the trade name of Beetle 60, 65, and 80, and benzoguanamine resin is sold by the trade name of Cymel 1123 and 1125.

[0071] The suitable photo-oxide generating agent compound used with the acid-resisting constituent of this invention is onium salt; [ like ] and Thackeray, although indicated by U.S. Pat. No. 4442197 which is referred to here and incorporated as a part, and 4603101 and 4624912. et A nonionic organic light activity compound like the halogenation light active ingredient indicated by U.S. Pat. No. 5128232 of al, sulfonate-ized ester, and a sulfonate photo-oxide generating agent like sulfonyl oxyketone is included. Benzoin tosylate, t-buthylphenyl Alpha (p-toluenesulfonyloxy)-acetate and t-butyl J.of which indicates suitable sulfonation PAGS(s) including alpha (p-toluenesulfonyloxy)-acetate Photopolymer Science and Refer to Technology and 4(3):337-440 (1991). Desirable sulfonate PAGs is Sinta again. et It is indicated by United States patent No. 5,344,742 of al. The above-mentioned camphor sulfonate 1 and PAGs 2 is a desirable photo-oxide generating agent for the resist constituent used with the acid-resisting constituent of this invention, and is desirable in the chemical magnification resin of this invention especially.

[0072] The photoresist used with the acid-resisting constituent of this invention can contain other matter again. For example, an AKUCHI nick (actinic) and a contrast color (contrast dyes), a striation-proof agent (anti-atriation agent), a plasticizer, a speed enhancer (speed enhancers), etc. are included as an additive of other arbitration. Typically, the additive of such arbitration exists by little concentration in a photoresist

constituent except a bulking agent (fillers) like the amount of 5 to 30 percentage by weight which is comparatively alike and exists by big concentration and the color of a desiccation component of total weight. [ of a resist ]

[0073] The acid-resisting constituent of this invention containing a low basicity cross linking agent like suitable glycoluryl is useful to especially the photoresist that generates a strong acid Mitsuo product like a triflic acid, camphor sulfonate, other sulfonic acids, or other acids that have about two or less electric dissociation exponent at 25 degrees C in exposure. Shipley mentioned above Refer to the Europe patent application of Company.

[0074] In an activity, the acid-resisting constituent of this invention is applied to a base as an enveloping layer by various approaches like spin coating. Generally, an acid-resisting constituent is applied on a base by the desiccation thickness between about 0.02 to 0.5 micrometers. Preferably, it is about 0.04 to 0.20-micrometer desiccation thickness. Any base used in the process which uses a photoresist is suitable for a base. For example, a base can be silicon, diacid-ized silicon, or aluminum-aluminum-oxide micro electro NIKKUWEHA. Gallium arsenide, a ceramic, a quartz, or a copper base can also be used. The base used for a liquid crystal display or other flat-panel display applications is also used suitably. For example, a glass base, an indium There is a stannic-acid ghost coat base etc. The base of an optics and optical-electronic device (for example, waveguide (waveguides)) is also used.

[0075] When a cross-linking acid-resisting constituent is used, as for the applied acid-resisting enveloping layer, it is desirable to harden, before a photoresist constituent is applied on it. Hardening conditions change with the components of an acid-resisting constituent. Therefore, when a constituent does not contain an acid or a heat acid generator, nearby becomes intense from that of the constituent with which curing temperature and conditions contain the acid or the acid generator compound. Typical hardening conditions are about 120 degrees C to 225 degrees C in 40 minutes after about 0.5. As for hardening conditions, what makes an acid-resisting constituent enveloping layer insolubility substantially also at an alkali aqueous developer and the solvent of a photoresist is desirable.

[0076] When carrying out bridge formation processing of high temperature after low floating heat treatment which adopted the "multistage hardening" approach of this invention and which was case [ heat treatment ] namely, mentioned above, the applied ARC constituent layer is first exposed to resin "floating" flattening heat treatment (planarizing thermal treatment) of the low temperature which changes a fluidity, and is exposed to the bridge formation temperature of an ARC constituent. However, suitable floating flattening heat treatment is performed for 2 minutes from about 1 at least at about 50 degrees C or 60 degrees C. It can opt for suitable floating flattening processing easily experientially about each ARC constituent. Then, an ARC constituent layer is processed at an elevated temperature in order to construct a bridge in a constituent.

[0077] A photoresist is applied on the front face of an acid-resisting constituent after such hardening. A photoresist may be applied like application of an acid-resisting constituent by spinning, dipping, the meniscus (meniscus), or the standard means of arbitration like roll coating. Since typically removes a solvent following application, it is heated by the photoresist enveloping layer until a resist layer becomes non-adhesiveness preferably. As optimal thing, mixing with an acid-resisting constituent layer and a photoresist layer does not occur in essence.

[0078] Then, image formation of the resist layer is carried out by the common use approach with an activation radiation through a mask. Its acid which carried out optical generating from PAG of an acid-resisting constituent in order to offer the image which activated the photograph activity compound of a resist system and was patternized by the resist enveloping layer is enough to exist in the interface of an acid-resisting constituent / resist enveloping layer while exposure energy activates some [ at least ] photo-oxide generating agents of the thickness direction of an acid-resisting constituent layer. Exposure energy is the range of about 1 to 300 mJ/cm<sup>2</sup> typically, and this is based a little on the operation of an aligner, the used concrete resist, and the used resist. In order that ARC may reduce notching and the footing which are not desirable, when the photo-oxide generating agent is included, the light exposure generally used for the typical image formation of a resist layer is sufficient amount to carry out optical activity of the effective dose of an acid in a lower layer acid-resisting constituent layer.

[0079] When it desires to generate the difference in the solubility between the range where the enveloping layer was exposed, and the range which was not exposed, or to enlarge, the exposed resist layer can be exposed to BEKU after exposure (post-exposure bake). For example, many chemical magnification positives resist which need exposure afterbaking for a negative-mold acid hardening photoresist wanting to produce acid acceleration crosslinking reaction typically need exposure afterbaking, in order to carry out induction of the deprotection reaction (deprotection reaction) by which acid acceleration is carried out.

typical -- the baking conditions after exposure -- the temperature of about 50 degrees C or more -- it is the temperature of the range of about 50 to 160 degrees C in more detail.

[0080] The exposed resist enveloping layer is developed after that. Negatives are developed with an aqueous base developer preferably like the inorganic alkali illustrated with tetrabutylammonium, hydroxide, a sodium hydroxide, a potassium hydroxide, a sodium carbonate, sodium bicarbonate, a sodium silicate, a meta-sodium silicate, an aqueous ammonia solution, etc. An organic developer can also be used as an exception method. Generally, development is performed according to the approach learned by this contractor. Last BEKU of an acid hardening photoresist is performed for several minutes at the temperature of about 100 to 150 degrees C following development. Thereby, the field of the enveloping layer developed and exposed hardens further.

[0081] In the field of a base to which the developed base does not have a photoresist after that, processing is performed selectively. For example, chemical etching or plating is carried out to the base field which does not have a photoresist to this contractor according to a well-known approach. as suitable etchant -- a hydrofluoric-acid etching reagent and the oxygen plasma -- plasma gas dirty \*\*\*\*\* which is dirty. Plasma gas dirty \*\* and the anti halation enveloping layer over which the bridge was constructed are removable.

[0082] All the reference shown here is incorporated as reference here. The example which is not restrictive as for a degree illustrates this invention.

[0083] Example 1 Synthetic 9-anthracene methyl of an ARC polymer Methacrylate (155.63g), 2-hydroxyethyl Methacrylate (65.07g) and methyl methacrylate (65.62g) were dissolved in the ethyl lactate which is 1850g. Indirect desulfurization of this solution was carried out by the stream of desiccation nitrogen for 15 minutes, and it was heated at 50 degrees C. It dissolved in 110g ethyl lactate, and the polymerization initiator (2 and 2' azobis (2-methyl butanenitrile)) (23.217g) heated this solution so that 85 degree C quickly added by the flask might be maintained. It continues for 24 hours and continued heating at 85 degrees C. This solution was cooled to the room temperature. The polymer product was settled in the deionized water of 12L, was isolated, and carried out the vacuum drying of it. Yield is 100%. By the polystyrene criterion, as for molecular weight (Mw), 8355 was obtained, and, as for Tg, the 103-degree C object was obtained.

[0084] Example 2 To ethyl lactate of 200g of composition of the low-molecular-weight ARC polymer using a chain transfer agent, it is 9-anthracene methyl. Methacrylate (15.56g), 2-hydroxyethyl Methacrylate (6.51g) and methyl methacrylate (6.59g) were dissolved. 2.01g of t-dodecyl thiols was added as a chain transfer agent. Indirect desulfurization of this solution was carried out by the stream of desiccation nitrogen for 10 minutes, and it was heated by 50 degrees C. The 1.015g polymerization initiator (2 and 2' azobis (2-methyl butanenitrile)) was added, and it was heated so that 85 degrees C might be maintained. The solution was heated by 85 degrees C for 24 hours. The solution was cooled to the room temperature and it diluted with the 50g further ethyl lactate. The polymer product was isolated as precipitate in the hexane of 2L, and carried out the vacuum drying of it. Yield was 86%. The molecular weight (Mw) made polystyrene the criterion, and 6304 and Tg were 101 degrees C.

[0085] Example 3 9-anthracene methyl methacrylate (15.58g), 2-hydroxyethyl methacrylate (6.51g), and methyl methacrylate (6.58g) were dissolved in ethyl lactate of 200g of composition of a chain transfer agent and a low-molecular-weight ARC polymer. t-dodecyl thiol (4.06g) was added as a chain transfer agent. By the stream of desiccation nitrogen, for 10 minutes, it was deaerated and the 1.012g polymerization initiator (2 and 2' azobis (2-methyl butanenitrile)) heated by 50 degrees C was added, and this solution was heated so that 85 degrees C might be maintained. A solution is 85 degrees C and was heated for 24 hours. The solution was cooled by the room temperature. The reaction solution precipitated in t-butyl methyl ether of 800mL. Mixture was filtered and collected ligours(es) were condensed. The produced oil was settled in the heptane of 300mL(s), and carried out the vacuum drying of this. Yield is 21%. In the polystyrene criterion, molecular weight (Mw) was 2337 and Tg was 60 degrees C.

[0086] Example 4 Synthetic 9-anthracene methyl methacrylate (33.21g) of the ARC polymer using the low monomer of Tg, HEMA-5 (namely,  $\text{CH}_2=\text{C}(\text{CH}_3)\text{COO}(\text{CH}_2\text{CH}_2\text{O})_4\text{CH}_2\text{CH}_2\text{OH}$ ) (15.36g), and methyl methacrylate (8.00g) were dissolved in 430g ethyl lactate. By the stream of desiccation nitrogen, for 10 minutes, this solution was deaerated and was heated by 45 degrees C. The polymerization initiator (2 and 2' azobis (2, 4-dimethyl pentane nitril)) (5.58g) was added, and it heated so that 85 degrees C might be maintained. 85 heating was continued for 24 hours. The solution was cooled to the room temperature. In the deionized water of 2.5L, the polymer product was isolated as precipitate and the vacuum drying was carried out. Yield is 79%. The molecular weight (Mw) of 4963; Tg was 50 degrees C in the polystyrene criterion.



[0087] Example 5 The desirable ARC constituent of this invention which has preparation of the low-molecular-weight resin ARC constituent of this invention and an operating low-molecular-weight polymer is prepared by mixing the following components. The (1) resin:terpolymer (2) cross linking agent of 88% of the above-mentioned example 1 expressed by the weight section based on the total solids (all components except a solvent carrier) of a liquefied acid-resisting coat constituent in the amount of components: It is 11% of Powderlink1174 (American Cyanamid).

(3) Photo-oxide generating agent : 0.5% of G t-butyl Diphenyl Iodonium Camphor sulfonate (4) acid: 0.3% of p-toluenesulfonic-acid monohydrate [0088] An ARC constituent is prepared in the solvent of ethyllactate. The spin coat of the liquefied ARC constituent is carried out on a silicon wafer base, and heat curing is carried out after that for 60 seconds at 175 degrees C. This hardening ARC layer is Shipley. It is finished by the positive type photoresist UV 5 which can come to hand from Company. Software BEKU (softbake) of the resist layer is carried out, and it is exposed with the patternized radiation, and are BEKU [ on a vacuum hot plate / after exposure ] it, and it is developed with an alkali aqueous solution. Plasma dirty [ of the base front face where a lower layer ARC layer sleeps together with oxygen / fluorocarbon plasma and where it becomes a base ] is carried out.

[0089] Example 6 The desirable ARC constituent of this invention containing the manufacture and the activity plasticizer containing a plasticizer of the ARC constituent of this invention is suitably prepared by mixing the following components. 6[ 2 and ]-screw (2', 4'-dihydroxy benzyl) 4-methyl-phenol [ terpolymer (2) plasticizer:/ 20% of ] (3) cross linking agent of the (1) resin:68% above-mentioned example 1 expressed by the weight section based on the total solids (all components except a solvent carrier) of a liquefied acid-resisting coat constituent in the amount of components: It is 11% of Powderlink1174 (American Cyanamid).

(4) Photo-oxide generating agent : 0.5% of G t-butyl Diphenyl Iodonium Camphor sulfonate (5) acid: 0.3% of p-toluenesulfonic-acid monohydrate [0090] An ARC constituent is prepared in the solvent of ethyllactate. The spin coat of the liquefied ARC constituent is carried out on a silicon wafer base, and heat curing is carried out after that for 60 seconds at 175 degrees C. This hardening ARC layer is Shipley. It is finished by the positive type photoresist UV 5 which can come to hand from Company. Software BEKU (softbake) of the resist layer is carried out, and it is exposed with the patternized radiation, and are BEKU [ on a vacuum hot plate (vacuum hot plate) / after exposure ] it, and it is developed with an alkali aqueous solution. Plasma dirty [ of the base front face where a lower layer ARC layer sleeps together with oxygen / fluorocarbon plasma, and serves as a base ] is carried out.

[0091] Example 7 The :95.5 % of the weight propylene glycol monoethyl ether solvent prepared because the ARC constituent of 2 hardening system this invention mixes the following component; it is 4.5% of the weight of solid content. This solid content is 86.95% of the weight of the terpolymer (ANTMA/HEMA/MMA) not more than molecular weight (Mw)12000, 11% of the weight of Powderlink1174 cross linking agent, 0.8% of the weight of a surface lubricating agent (FC430 which can come to hand from 3M Co.), and 0.5% of the weight of JI. tert-butyl Phenyl Iodonium PAG of camphor sulfonate, and 0.75% of NacureX49 (KingIndustries) heat acid generator.

[0092] The spin coat of this ARC constituent is carried out by 2500rpm on a wafer base, it is made into the thickness of 1200A, and is hardened at 200 degrees C after that. The resist profile permissible by this was obtained and the 0.53NA lens was exposed by 9.2 mJ/cm<sup>2</sup> with 248nm radiation.

[0093] According to the further test of ARCs of this invention containing the heat acid generator NacureX49, after 125-degree C hardening constructed the bridge slightly. (It lost 90% in the solvent of ethyllactate) .

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[Translation done.]



**\* NOTICES \***

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- 1.This document has been translated by computer. So the translation may not reflect the original precisely.
- 2.\*\*\*\* shows the word which can not be translated.
- 3.In the drawings, any words are not translated.

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**DRAWINGS**

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**[Drawing 1]**

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[Translation done.]